

## **External Elective Choices for Biochemistry Majors**

There are courses in other A&S UG programs, and in the Biomedical Sciences Graduate Program within the School of Medicine, that can be used as upper level electives for the Biochemistry degree. You can use ONE of these outside-of-the-Biochemistry-department courses as an upper-level elective to meet the requirements for the program.

Please keep in mind that not all of these courses are offered every year; some are offered in alternate years, and some are offered only when the instructor has sufficient enrollment. Also, your enrollment into any of these courses will be at the discretion of the course instructor. He/she may have to override pre-requisite courses and capacities, and only the instructor of record can make this determination.

### **External Undergraduate Elective Choices**

**Biol 410 Ecology and Evolutionary Genomics** - This course focuses on methods, both experimental and computational, to study the structure of genomes and to analyze gene expression and protein function on a genome-wide scale. Computational topics include graphic approaches in sequence assembly; discriminant analysis in gene finding; dynamic programming in sequence comparison; and clustering techniques in the analysis of gene expression data.

**Biol 412 Developmental Biology** - Comparative biology of animal development emphasizing regulatory mechanisms.

**Biol 461L Histology** - Microscopic structure of vertebrate tissues, emphasizing correlation of structure and function.

**Biol 425 Molecular Genetics** - Molecular biology of the gene.

**Biol 428 Human Heredity** - Genetic principles applied to humans.

**Biol 429 Molecular Cell Biology** - Cellular processes with emphasis on membranes; includes reading original landmark papers in cell biology.

**Biol 437 Evolutionary Genetics** - Mutation, natural selection, genetic drift; how evolutionary forces shape population structure. Mechanisms of speciation. Macroevolution of biochemical processes essential to higher organisms, such as signal transduction pathways, developmental genes and complex organs.

**Biol 444 Genomics and Genomic Analyses** - Overview of genomic analyses from DNA sequence to gene expression and proteomics.

**Biol 445 Biology of Toxins** - Principles of toxicology; pharmacology and biotransformation of xenobiotics. Mechanism of action, medical uses, and evolutionary ecology of biological toxins.

**Biol 446 Laboratory Methods in Molecular Biology** - Principles of DNA and RNA purification, enzymatic manipulation of nucleic acids, molecular cloning, gel electrophoresis, hybridization procedures and nucleotide sequencing.

**Biol 450 General Virology** - Structure, properties, and molecular biology of viruses; virus-host interactions, multiplication, pathology, epidemiology, effects of chemical and physical agents, classification.

**Biol 451 Microbial Ecology** - Role of microorganisms in terrestrial and aquatic ecosystems. Emphasis on biogeochemistry and nutrient cycling.

**Biol 452 Anthropological Genetics (Human Genetics)** - This course examines theory, data and methods used by genetic anthropologists to address questions about human origins and prehistory, race, natural selection, disease, and the social and scientific implications of research in genetic anthropology.

**Biol 456 Immunology** - Immunoglobulin structure, antigen-antibody reactions, immunity and hypersensitivity; experimental approach will be emphasized.

**Biol 460 Microbial Physiology** - Physiological and biochemical activities of bacteria and fungi with emphasis on cell energetics.

**Biol 482L Parasitology** - The protozoa and worms important in human and veterinary medicine. Emphasis on life histories, epidemiology and ecology of parasites with laboratory practice in identification and experimentation.

**Biol 490 Biology of Infectious Organisms** - The full spectrum of infectious entities including prions, viruses and parasitic prokaryotes and eukaryotes will be discussed with respect to their transmissibility, interactions with immune systems and their influences on evolutionary processes and biodiversity issues.

**Biol 497 Principles of Gene Expression** - A detailed and critical study of how different genes are regulated during the life of an organism, principally at the level of transcription.

**Chem 422 Molecular Biology of the Gene** - Focuses on the biological chemistry of gene structure, expression and regulation and the structure and function of the cell nucleus.

**Chem 425 Organic Chemistry of Biological Pathways** - Covers basic principles of mechanisms, acidity, stereochemistry; structures; properties of biomolecules; reactions in lipid, carbohydrate, amino acid, nucleotide metabolic pathways.

**Chem 457 Environmental Chemistry** - Introduction to the chemistry of natural and polluted environments, including both atmospheric and aquatic systems.

## **External Graduate Elective Choices**

If you choose to enroll in one of the following courses at the 500-level course, additional requirements must be met. Courses numbered above 500 are normally open only to graduate students; however, senior students with GPAs of 3.0 or higher may receive undergraduate credit in these courses. They must obtain approval in advance from the instructor concerned, the chair of the department, and the dean of their undergraduate college. Undergraduates may not enroll in graduate “Problems” courses for undergraduate credit.

**Biomed 509 Principles of Neurobiology** - This course covers cellular structure of neurons and glia, the electrical properties of neurons, intercellular communication, and the formation, maintenance and plasticity of chemical synapses.

**Biomed 510 Physiology** - Course in regulatory and systems biology, and cardiovascular and pulmonary biology.

**Biomed 515 Cancer Biology** - Fundamental elements of cancer development and progression will be the focus of this course. Basic biochemical and genetic mechanisms of tumorigenesis, including genomic instability, principles of tumor cell invasion and growth dysregulation will be emphasized.

**Biomed 516 Molecular Genetics and Genomics** - Covers genetic and genomic approaches in model organisms (prokaryotes, fungi, worms, mouse and fruit flies) and humans to study biological processes at the molecular, cellular, tissue, organism, population and evolutionary levels. Provides an introduction to bioinformatic and computational methods used in such studies.

**Biomed 522 Experimental Design and Methods in Molecular and Cellular Biosciences** - This case-based course is intended for first year graduate students and focuses on practical issues of how to design, plan and conduct scientific studies through appropriate use of experimental methods and data analysis.

**Biomed 532 Neurochemistry** - An introduction to neurochemistry and neuropharmacology, with heavy emphasis on student participation, by reading and evaluating current publications.

**Pharm 576 Cellular and Molecular Pharmacology (1 credit) WITH Pharm 580 General Toxicology (2 credits)** – Must be taken together.

- **PHRM 576. Introductory Pharmacology.** Pharmacology is a basic science concerned with all aspects of the action of drugs on living systems. In its entirety, pharmacology embraces biochemical and physiological effects, mechanisms of action, pharmacokinetics, and therapeutic and diagnostic uses of drugs. A strong working knowledge of pharmacology is essential to the professional role of pharmacists and to basic scientists engaged in drug discovery and understanding how drugs work. The goal of this course is to give an overview of the principles of modern molecular and cellular pharmacology, as well as some details of drug delivery. Topics include:

biopharmaceutical properties of drugs; receptor theory; absorption, distribution, metabolism and elimination; pharmacokinetics and drug delivery. It also serves as an Introductory course to PHRM 580 and PHRM 598 courses

- **PHRM 580 - General Toxicology.** Toxicology is an important broad-based discipline that incorporates information from many areas bridging the gap between molecular mechanisms of toxin activity to their implications in real-world problems. For the Spring 2015 semester, the General Toxicology course has been revamped to focus on basic scientific literature relevant to toxicology and the scientific method that are of interest to graduate students. Scientific literature relevant to toxicology and the scientific method are emphasized in all topics covered. The goal of this course is to give students a broad, but comprehensive, overview of the principles of toxicology. Topics will be taught by experts in each area and will include aspects of toxicology on relevant toxic agents, molecular and cell-based mechanisms of action, as well as details of target organ systems and physiology that are affected by toxins.